



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

be accepted as evidence that the person in question has swallowed material that has come from the bowels of some other person.

In this connection it may be mentioned that it is not rare to find from 10 to 40 or 60 per cent of the samples of feces examined in some localities to contain spores of one or another of the protozoa in question.

The practical application of these facts from a public health point of view is this: If any one of these parasites is found in a person, we are in a position to state to him definitely that we have positive evidence that he has swallowed material that has been contaminated with fecal matter, and if we find poor privy and fly conditions on or near his premises, we can state to him that the conditions in question are favorable to such contamination, and may explain the infection; also that it is a mere matter of chance that he has become infected with a relatively harmless parasite instead of with typhoid fever or dysentery.

It is self-understood that the possibility is not excluded that the infection was contracted in food shipped from some farm or from a distance, but the moral effect of the demonstration of infection and the possibility of its continuance may be expected to induce people to clean up the back yard.

TYPHOID FEVER.

A REPORT OF AN OUTBREAK AT FORT DODGE, IOWA.

By P. M. CARRINGTON, Surgeon, United States Public Health Service.

At the request of the State board of health of Iowa, the writer was directed by the Surgeon General to proceed to Fort Dodge, in that State, for the purpose of investigating an outbreak of typhoid fever, "especially with reference to the origin and prevalence of the disease," and was directed to advise the authorities in regard to its control, and in accordance with said orders arrived at Fort Dodge on October 28, 1912. The investigation was concluded November 8, 1912.

The town of Fort Dodge is situated about 80 miles northwest of Des Moines, on the Des Moines River, from which it in part derives its water supply and into which it discharges its sewage. Its situation is hilly, with good natural drainage in the direction of the river. The population is between 15,000 and 17,000. There are large deposits of gypsum in the vicinity and numerous mills for the manufacture of plaster of Paris and other products of gypsum.

The rock formation underlying the region is extensively fissured. Soldier Creek flows in a southwesterly direction through the northern section of the town, and empties into the Des Moines River just above the waterworks, but below the filter beds.

Squirrel Creek, which drains a suburban and farming community, empties into the Des Moines River about a half mile upstream from the pumping station.

The river bank for a distance of a half mile above the water-pumping station is lined with insanitary privies, many of which almost overhang the river banks, and an extensive public dump, where stable manure and miscellaneous city waste are thrown, is located just above the water-pumping station, and much of the dumping material actually falls into the stream.

The polluted water from Soldier Creek, which receives drainage from many privies and a public slaughter house, reaches the Des Moines River above the water tunnel below referred to, and the water supplied by this tunnel is probably subject to pollution through fissures in the rock. A sample of water taken November 4 from near the bottom of the shaft into which the tunnel leads showed typical red colonies of litmus-lactose-agar, but no gas.

The Des Moines River is a rapidly flowing stream, subject at times to heavy floods, but during the past summer it has been unusually and uniformly low, although frequent light rains have occurred, thus carrying into the river sewage from the numerous privies which line its banks. The watershed is thinly populated for a distance of more than 20 miles above Fort Dodge.

Other insanitary conditions favorable to the spread of typhoid fever were observed during an inspection of the city and suburbs, as follows:

There are many surface wells all over the town, and many insanitary privies in close proximity—some within 20 feet, none farther than 100 feet from one or more wells.

Stable manure is allowed to accumulate and stand for long periods.

Many receptacles for garbage are neither water tight nor fly proof.

A public slaughterhouse is maintained and drains into Soldier Creek.

Many citizens have not as yet connected their residences with the city water supply and city sewers where these conveniences are available, but still use shallow wells and the adjacent insanitary privies.

Ice is harvested below sewer outfalls. This has been permitted on the statement that this ice is used only for cooling purposes.

An inspection of the principal dairies was made, and while there was no indication that any one of them was concerned in the production of this outbreak, certain of the smaller ones leave much to be desired in the way of cleanliness and sanitation. The larger ones are fairly well conducted, and average care and cleanliness prevail.

The Oleson Park tap and drinking fountain, referred to later in this report, are two terminal taps derived from the same main, which

extends to the Plymouth gypsum mill, 1 mile south of the city limits, and supplies the workmen with drinking water. At this mill 8 cases of typhoid fever have developed this year. These cases are included in the total of 101 cases.

On my arrival at Fort Dodge I at once called upon the health officer, Dr. C. H. Mulroney, the mayor being absent.

It appears that the health officer, noticing the frequent allusions in the daily papers to persons being sick with typhoid fever, concluded that this disease must be more prevalent than usual, and inasmuch as there is no law in the State of Iowa requiring notification of typhoid fever and no city ordinance of Fort Dodge to this effect, he prepared blank forms, distributed them to the practicing physicians of the town, and requested that they report all cases of typhoid fever which had come under their care since June 1.

This duty the physicians readily undertook to perform, but inasmuch as it was to some extent a matter of memory, it is doubtful whether every case was reported, and especially is it doubtful whether the dates of onset were accurately stated. There being no public morbidity records from which statistics might be gathered, considerable difficulty was experienced in securing reliable information of the past prevalence of the disease.

At various times during the past year bacteriological examination of the water by the Iowa State Laboratory has demonstrated sewage pollution, but as it seemed desirable to make further examinations, the health officer was requested to and did order the necessary media and apparatus for conducting such examinations.

There was some delay in the filling of this order, and in the meantime Dr. E. E. Richardson, a member of the State board of health residing at Webster City, learned of my presence in Fort Dodge through a newspaper publication, and called me up on the long distance telephone November 1, urging me to come to Webster City for a conference. The distance being only 20 miles, a visit was paid him that afternoon. He furnished such data as he had been able to collect regarding the outbreak, and said that the State board desired to have a representative work with me on this investigation, and that he would, if agreeable to me, secure the detail of the bacteriologist from the State laboratory for this purpose. The proposal was accepted; the more willingly, because the apparatus ordered by Dr. Mulroney had not been received, and to await its arrival would have prolonged unduly my stay in Fort Dodge.

Accordingly, Mr. A. M. Alden, assistant director of the State laboratory, arrived at Fort Dodge the following night, and was thereafter associated with me in the investigation. We worked

together in perfect harmony, mutually assisting one another, and it is a pleasure here to testify to our friendly and mutually helpful association. A copy of Mr. Alden's report to the mayor is hereto appended.

WATER SUPPLY.

The water supply of Fort Dodge is derived from a number of sources:

First. Shallow wells are numerous throughout almost the entire town.

Second. The public city supply is derived from three sources:

The Des Moines River; by means of a filter bed composed of perforated pipes laid in the bed of the river above Duck Island, under three or four feet of coarse gravel;

Three artesian wells; and

A shaft about 6 by 8 feet, and 80 feet deep, near the bottom of which is a 9 foot twin tunnel extending from the pump house, as shown on the accompanying map, directly west under the bed of the river and Park Island.

This tunnel and shaft supplies 80 gallons of water per minute; well No. 1 supplies 400 gallons of water per minute; well No. 2 supplies 150 gallons of water per minute; well No. 3 supplies 500 gallons of water per minute.

Well No. 1 was sunk six years ago, and wells Nos. 2 and 3 are only about a year old.

The water from well No. 1 overflows into the shaft above referred to, whence it flows into the mixing basin, into which also the water from wells Nos. 2 and 3 flows. The river supply also flows by gravity into this receptacle, where the water from all sources is thoroughly mixed before entering the mains. The wells and shaft furnish approximately a million and a half gallons per diem, and the daily usage is about 1,000,000 gallons, but inasmuch as there is no storage except a small pressure tank in the center of town, which serves to maintain the pressure when the pumps are temporarily shut down for an hour or two at night, the current flow is not equal to the greatest current use, therefore it becomes necessary to take water from the river during the hours of greatest use, the surplus from the wells during the night hours going to waste.

SEWAGE.

The city has a good and growing sewage system, extending at present to about two-thirds of the town and discharging into the Des Moines River by six or more outfalls. The most northerly is a few hundred yards below the waterworks. There are many dwellings

for which the public sewers are available, but which are not as yet connected therewith, the sewage from these houses being deposited in privies, which are apparently cleaned only so often as the householder elects. The sewage from these privies is conveyed several miles into the country and dumped.

PREVIOUS PREVALENCE OF THE DISEASE.

Cases of typhoid fever have not been made notifiable in Iowa. Consequently, the only public record from which any idea of the previous prevalence of the disease could be obtained was the record of deaths. Under the Iowa law, deaths are reported to the secretary of state at the close of each month by the undertakers. The undertakers secure death certificates from the physicians, and, while they are supposed to secure a certificate prior to burial, in practice they seem to go around at the close of the month to the various physicians and secure their signatures to the certificates of deaths that have occurred during the month. After the close of the fiscal year on June 30, a transcript of these reports is furnished by the State department to the county clerk.

An examination of these records was made for the five years ended June 30, 1911, the transcript for the fiscal year 1912 not as yet having been received by the county clerk. The record shows the following deaths from typhoid fever in Webster County (population, 35,000), of which Fort Dodge is the county seat:

Fiscal year 1907, 6 deaths; fiscal year 1908, 5 deaths; fiscal year 1909, 4 deaths; fiscal year 1910, no deaths; fiscal year 1911, 3 deaths.

From other sources it was learned that there had been four deaths from typhoid fever in the city of Fort Dodge during the present calendar year.

From the records of the only hospital in Fort Dodge it was learned that 19 cases of typhoid fever had been treated during the calendar year 1911, and 12 cases during the current calendar year. Some of these 12 are included in the record of cases given later in this report, but I am not certain that all are included.

PREVALENCE OF TYPHOID FEVER IN 1912.

	Cases.
January 1 to May 31.....	28
June.....	4
July.....	6
August.....	7
September.....	31
October.....	25
Total.....	101

The following is a table showing the dates of onset, as nearly as could be ascertained, of the cases occurring in September and October:

Day.	Sept.	Oct.	Day.	Sept.	Oct.
1.....	2	5	17.....	1	1
2.....		1	18.....	2	1
3.....		1	19.....		1
4.....	2		20.....	1	1
5.....		1	21.....	1	2
6.....			22.....		
7.....	1	2	23.....	2	
8.....			24.....		
9.....	1	1	25.....	1	2
10.....	4	1	26.....	2	1
11.....	1		27.....	3	
12.....		2	28.....	1	
13.....	1		29.....	1	
14.....		1	30.....		
15.....	2		31.....		
16.....	2	1			

Taking the total number of cases occurring since June 1, on some of which only partial data could be obtained, it is found that 49 used the city water exclusively, 21 used both well and city water, while only 4 used well or spring water exclusively. Of the total of 73 cases, 11 gave a clear history of contact. Thirty-nine, or more than one-half, denied the use of milk altogether. Forty-four were males and 29 females.

Age distribution.

	Cases.
Under 10 years.....	15
10 to 20 years.....	21
20 to 30 years.....	23
30 to 40 years.....	8
40 to 50 years.....	6
Total.....	73

A careful epidemiological study was made of 30 cases, sick or convalescent at the time of my visit. The physicians very willingly took me to see their cases, all of which were, clinically, typical typhoid, a number being very serious cases, such complications as hemorrhage and double parotitis being noted. Widal's were made in several cases; all were positive. Of these 30 cases studied 8 were under 10 years of age; 9 between 10 and 20 years; 9 between 20 and 30 years; 2 between 30 and 40 years; and 2 between 40 and 50 years; 20 were males and 10 females; 5 were clearly contact cases.

One case was almost surely a milk infection, having drunk milk supplied by a neighbor who nursed her own daughter and milked the cow from which this case was supplied with milk, this being the only person to whom she supplied milk.

Eleven patients denied the use of fresh milk in any form, and 19 used milk as a beverage or in tea and coffee, but their milk supply was derived from various sources.

An attempt was made to ascertain the use of ice cream and raw vegetables and fruits, but while a majority had been in the habit of eating ice cream and raw vegetables and fruits, the source of supply could not be located with sufficient accuracy to be of any value.

In only 11 cases was there modern plumbing in the houses, and while at the time of my visit there were but few flies, the usual testimony was that they had been numerous during the summer.

The general sanitary condition of the houses visited was fair to good in 19 and poor to very poor in 11.

All of these cases derived their drinking water from the city mains, either wholly or in part.

From the foregoing it appears that the only common cause to which any considerable majority of these cases was exposed was the known polluted water. Eleven contact cases and one milk case seem to be fairly well established.

It is probable also that some cases may have been caused by flies, which were numerous during the month of September, but which were not numerous after the first week in October. There is a possibility also that some cases may have been caused by infected well water, but it is believed that the epidemic is traceable to the city water.

The distribution of the disease in the town was very largely in the southern portion, only 8 cases out of 73 having occurred in that portion of the town north of Central Avenue, and at least 2 of these were traced to the use of city water in the southern part of the town at Oleson Park. One of these cases is particularly instructive:

R. W., age 9, the daughter of intelligent and well-informed parents, who, fearing the city water, had carefully prevented her drinking any but boiled water. August 18 to 25 a Chautauqua meeting was held in Oleson Park, many citizens, including the W. family, camping on the grounds; R., with other children, drank from the newly erected drinking fountain in the camp grounds. She returned to her home and became sick with definite symptoms of typhoid fever September 5, the probable date of onset being given as September 1.

On October 14 the city authorities, on the advice of Prof. Kinney, State chemist, instituted hypochlorite treatment of their water supply.

The last but one case reported had its onset not later than October 26. The one exception was a clear contact case, having onset November 1, and is not included in the total of 101 cases, my record closing with October. Six cases among workmen of the Illinois Central Railroad roundhouse, where they drank from a neighboring well, elicited considerable local comment as to the probability that the well was the source of infection, but these men all drank city water at their homes, and no member of the family using the same well as an exclusive water-supply source contracted the disease.

The epidemic is charged to the city water for the following reasons:

First. Known sewage contamination of the water.

Second. Sixty-nine out of 73 cases had derived their drinking water, in whole or in part, from the city mains.

Third. There was no other known factor common to a majority of the cases.

Fourth. Continuation of cases more than two weeks after most of the flies had been killed by cold weather.

Fifth. The sudden cessation of cases 12 days after the institution of hypochlorite treatment.

GENERAL CHARACTER OF THE EPIDEMIC.

The doctors of Fort Dodge state that during August of this year an extensive epidemic of diarrhea prevailed. The cases were severe but of short duration, usually not over two or three days.

The cases of typhoid which I saw were of rather more than average severity, but a number of cases were reported to have recovered within three weeks. The occurrence of 100 cases in 10 months in a population of 15,000 is equivalent to a case rate per annum of 800 per 100,000.

The case fatality rate was low—about 4 per cent—but several cases contracted in Fort Dodge went elsewhere for treatment, and at least one of these is known to have resulted fatally.

The occurrence of 11 cases, probably by contact, indicates that the physicians' orders regarding bedside precautions against infection were not carefully carried out, and the importance of reiterating instructions to persons nursing typhoid cases was urged upon them. Some of the physicians were using protective inoculations, and were advised to continue and extend these inoculations as far as possible.

It having been decided that the water was responsible for this outbreak, the question arises as to why the disease should have been so much more prevalent in the southern than in the northern side of town. The possibility of some physical or mechanical reason why a greater percentage of river water should have reached the pipes in the southern part of town was considered and carefully gone over by Mr. Alden and myself. This included a careful inspection of the pump house and the method of mixing the water from the various sources prior to its entry into the mains. Previous examinations of the water had shown a higher degree of contamination in the Oleson Park tap and drinking fountain than at the intake.

The entire water system has an unusually large number of dead ends. These are really more numerous in the northern than in the southern section, but on the other hand, feeling that the natural circulation in the southern section was better than in the northern, there was more frequent flushing of the pipes in the northern section. Citizens

reported that certain mains in the southern section—and the mains particularly referred to are those supplying the districts where the fever was most prevalent—had not been flushed in 15 and 24 months, respectively. The water superintendent denies so long an interval, but admits that these pipes were flushed less frequently than in the northern part of town.

There is an added reason for the probable slower movement in these pipes in the fact that the mains in this section were laid with a view to supplying certain gypsum mills, and are therefore much larger than is necessary, since the expectation of supplying the mills was not realized.

The pressure tank referred to is emptied and cleaned only twice annually. Owing to the greater use of water in the southern part of town more of the flow from this tank, when the pumps are stopped, would flow to the southern section than to the northern section of town.

RECOMMENDATIONS SUBMITTED TO THE MAYOR AND COUNCIL.

(1) Secure a supply of pure water immediately. This may be accomplished by one of two methods:

(a) The plan at present in contemplation and in course of accomplishment, that is to say, the completion of the 2,000,000-gallon reservoir on Park Island, and the piping off of well No. 1 so as to exclude the water from the shaft, as no sewage contamination has ever been found in any one of the three artesian wells. This method, which will conserve the entire flow, will quickly give a safe supply of a sufficient quantity of water for present needs.

The growth of the town, however, and the extension of the water mains to portions of the town not at present supplied will soon require more water than the present wells will supply. Further, the artesian water has a high degree of permanent hardness, and is not a good water for commercial and industrial purposes.

Therefore, the second plan may of necessity come up for consideration in the near future.

(b) An entirely new plant located well above the town and local sources of pollution, the water to be taken from the Des Moines River and settling basins and filter beds provided. This plan would require the services of a sanitary engineer. In the meantime, and pending the completion of the reservoir, and so long as the water from the shaft is used, it is recommended (1) that the hypochlorite treatment be continued.

(2) It is recommended that all householders be required to connect with the city water and sewer systems where these are available, and that the water and sewer systems be extended as rapidly as funds are available for the purpose.

(3) Condemn and discontinue all surface wells and privies in such localities.

(4) Substitute sanitary closets for privies where sewers are not available.

(5) More frequent flushing of mains and terminal taps and more frequent cleansing of pressure tank.

(6) Connect all dead ends.

(7) Rigidly enforce city ordinances and State laws relating to the disposal of garbage and stable manure.

(8) Discontinue the use of the public slaughterhouse on Soldier Creek.

(9) Prohibit harvesting of ice below sewer outfalls. While this ice may be used only for cooling, this includes the freezing of ice cream, and it is a practical impossibility to avoid contaminating the ice cream with the melting ice.

(10) Establish a modern health department, paying the health officer sufficient compensation to enable him to give his entire time to the duties of the department.

CONCLUDING REMARKS.

During my stay at Fort Dodge I spoke by request before the local medical association on the Public Health Service, Its History and Functions, and on the Method of Conducting an Epidemiological Investigation.

I also spoke before a meeting of the mayor and council—to which citizens were invited—on the Causes of the Outbreak, and the Remedies Proposed.

Upon invitation of the president, I addressed the woman's club of Fort Dodge, the mayor and council and a number of citizens also being present.

Acknowledgment is made of many courtesies and valuable assistance rendered by the health officer, Dr. C. H. Mulroney.

Mayor Ford and Water Superintendent Pray showed many courtesies; and they and the physicians of Fort Dodge rendered every possible assistance.

It should be mentioned that on or about November 1 the hypochlorite plant was shut down for 24 hours for repairs, and because the stock of hypochlorite had become exhausted. It would not be surprising, therefore, if additional cases should develop about November 12 to 15.